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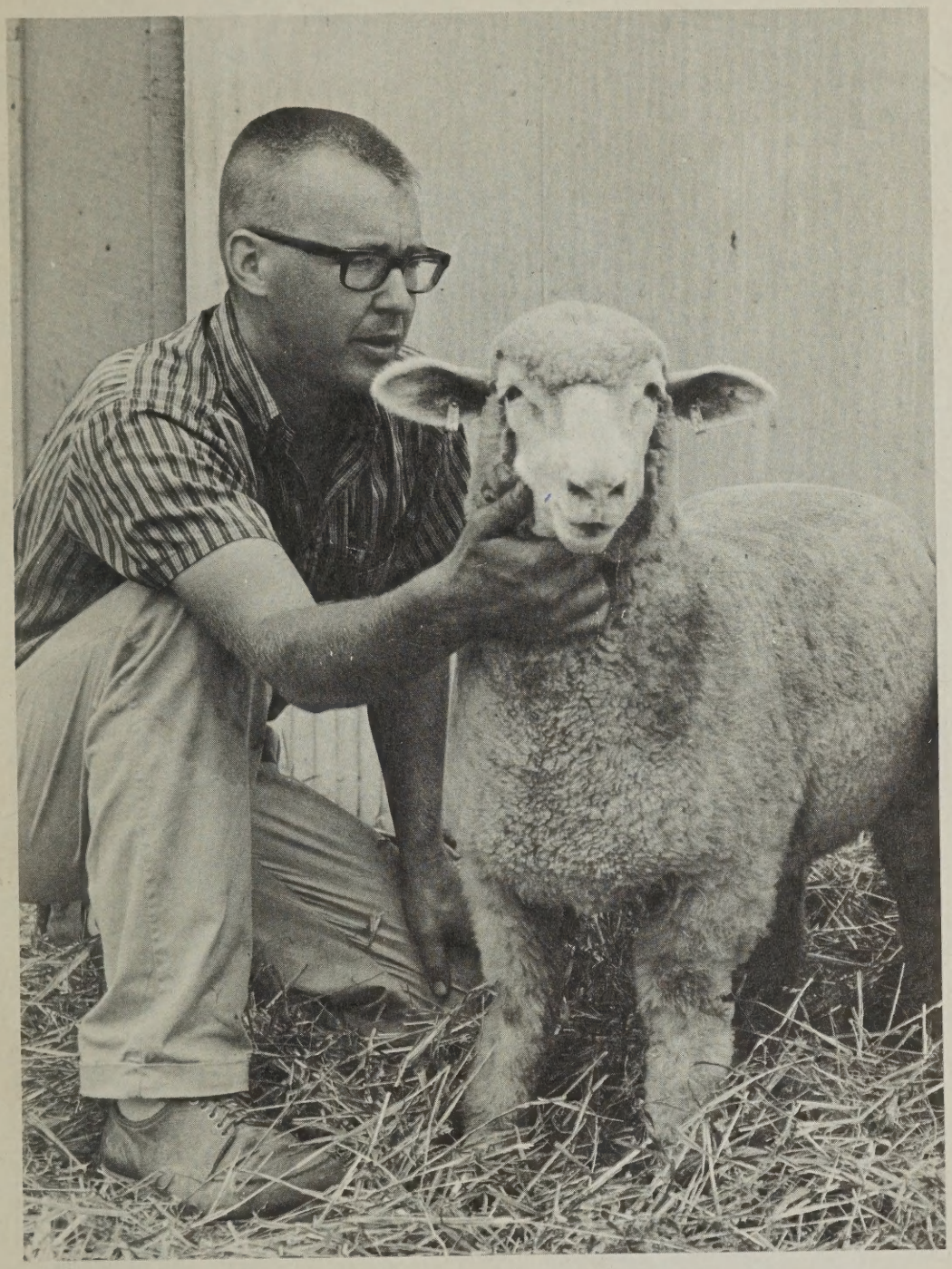

SHEEP DAY

Dec. 10, 1965

FEB 28 1966
UNIVERSITY OF ILLINOIS

DEPARTMENT OF ANIMAL SCIENCE
UNIVERSITY OF ILLINOIS
COLLEGE OF AGRICULTURE
URBANA, ILLINOIS

G R E E T I N G S

This report and this day were planned to be useful to those interested in the sheep industry. Your interest in the University of Illinois and its programs is stimulating and helpful to the staff. We hope you will make yourself at home, visit the University facilities, and consult with particular staff members as your interests direct.

New on our staff this year is Larry A. Arehart, Jr., who joined the Animal Science Department on July 1 as a full-time assistant. Under the direction of Professor J. M. "Jack" Lewis, he is responsible for the operation of the sheep unit at the Dixon Springs Agricultural Center, Simpson, Illinois. Larry is no stranger to the sheep industry, having worked his way (with the help of his capable wife, Patsy) through Virginia Polytechnic Institute by assisting with sheep research projects, doing custom shearing, and developing his own purebred flock. He served in the Army before obtaining his B.S. degree at V.P.I. Larry (see cover picture) and Patsy are a fine addition to our research "team" and we welcome them.

Our program this year reports research and events involving various aspects of the sheep industry with which we have been concerned since we last met. The featured speaker is Professor "Don" Bell, one of the real "deans" of the sheep industry, who will be retiring next year from active service at the Ohio Agricultural Research and Development Center at Wooster. His ideas are always "fresh," and it is a real treat to have him with us.

We think you will also be interested to hear Mrs. Fred Francis, Illinois Director, report on the Make-It-Yourself-With-Wool participation in the state. As you know, this activity is supported partly by sheep producers under a provision of the National Wool Act of 1954. This year Illinois will be one of the top states, if not the top one, in MIYWW participation. It is good to have an activity that develops capability in people and at the same time promotes an agricultural product, wool.

We welcome your comments and suggestions at all times. We think that this day can be as useful to the industry as those in the industry want to make it. It is our hope that you will find today's program and exhibits both stimulating and interesting.

U. S. Garrigus
For the Ruminant Division
and other participants

12/10/65

ILLINOIS SHEEP DAY

Animal Science Department
University of Illinois
Urbana, Illinois
December 10, 1965

MORNING SESSION

8:30 OPEN HOUSE at Sheep Farm Facilities and Metabolism Laboratory

STOCK PAVILION

Chairman - G. E. Ricketts, Extension Specialist, Sheep and Beef Performance Testing

10:00 Opening Comments. . . . . .G. E. Ricketts

10:10 Influence of Diethylstilbestrol on the Feed Efficiency and Carcass Merit of Lambs . . . . . .U. S. Garrigus

10:25 Nitrogen Sources, Diethylstilbestrol Implants, and Slotted Floors for Early-Weaned Lambs . . . . . J. M. Lewis
Dixon Springs Agricultural Center

10:50 Supplementation of Silages With NPN . . . . . .E. E. Hatfield

11:05 Comments on Live Animal and Carcass Evaluation. . . . . B. B. Doane

11:25 Use of the K-40 Counter in Sheep Research . . . . . .T. G. Lohman

11:35 Pasture and Forages for Sheep . . . . . .C. N. Hittle
Agronomy Department

11:50 Questions

12:00 LUNCH in Stock Pavilion . . . . . .Hoof and Horn Club

AFTERNOON SESSION

Chairman - R. O. Nesheim, Head, Department of Animal Science

1:00 "Make-It-Yourself-With-Wool". . . . . Mrs. Fred Francis
Illinois State Director of Make-It-Yourself-With-Wool Contest

1:15 Welcome . . . . . O. G. Bentley
Dean, College of Agriculture

1:30 Sheep Production--Past, Present, and Future . . . . . .D. S. Bell
Ohio Agricultural Research and Development Center

2:15 How Can We Improve Sheep Production in Illinois?. . . . . .G. E. Ricketts

2:30 Adjourn

2:45 Annual Meeting, Illinois Purebred Sheep Breeders' Association . . . . . .R. E. Reed, Libertyville

TABLE OF CONTENTS

	Number
Influence of Diethylstilbestrol on Feed Utilization and Carcass Merit in Lambs.	AS-629a
Effects of Supplementary Sulfur and Diethylstilbestrol (DES) on Animals Fed a Corn Silage-Concentrate-Urea Diet.	AS-629b
Study of Various Supplementary Nitrogen Sources When Ensiled With High-Concentrate Silages.	AS-629c
Chemical Characteristics of Supplemented Silage	AS-629d
Effect of Ensiling Energy and/or Nitrogen Supplements With Corn Silage.	AS-629e
Effect of Diethylstilbestrol Implants on the Performance of Early-Weaned Lambs (20-343)	AS-629f
Influence of a Dietary Supplement of B-Vitamins on the Performance of Early-Weaned Lambs	AS-629g
Influence of Level of Dietary Nitrogen and Supplemented Amino Acids on the Growth and Nitrogen Utilization of Early-Weaned Lambs.	AS-629h
Studies of Amino Acid Metabolism in the Ruminant.	AS-629i
Floor Space Requirements of Lambs Confined to Elevated Slotted Floors (20-343)	AS-629j
Altering the Digestive Processes of Lambs	AS-629k
Illinois "Spot" Wool Marketing Pools.	AS-629ℓ
Comment on Live Animal and Carcass Evaluation	AS-629m
Use of K-40 in Sheep Research	AS-629n
Summary of 1964 Ewe Flock Production.	AS-629o
Urea and Ammonia Metabolism in the Ruminant	AS-629p
Biological Evaluation of Purified Diets for Lambs, With Emphasis on the Utilization of Certain Dietary Components as Affected by Branched-Chain Volatile Fatty Acids	AS-629q
Nitrate Poisoning: A Chemical and Biological Evaluation of Potassium Nitrate Utilization by the Growing-Fattening Lamb	AS-629r

Agricultural Experiment Station
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University of Illinois

College of Agriculture
Animal Science Dept.
Ruminant Division
AS-629a

INFLUENCE OF DIETHYLSTILBESTROL ON FEED UTILIZATION AND CARCASS MERIT IN LAMBS

U. S. Garrigus

The 1959 report by Andrews and coworkers at Purdue University (JAS 6:3) that implanting lambs with diethylstilbestrol (DES) increased rates of gain has been followed by many reports on this subject. In general, the various conclusions have led to confusion about the practice.

Some observations have tended to cast doubt on the desirability of using DES in lamb-finishing programs. For example, DES treatments have been reported to (1) cause lamb pelts to adhere more strongly to the carcass (Illinois Sheep Day Report, 1959, p. 40), (2) increase the incidence of "water belly" where urinary calculi are already a problem, (3) cause breakjoints of older lambs to solidify at a slightly younger age, (4) increase carcass cooler shrink, (5) lower carcass grade, and (6) increase the incidence of rectal and/or vaginal prolapse.

All of these objections have some valid basis. However, optimum feeding conditions will practically eliminate these problems, and the DES will increase rates of gain 10 to 40 percent (12 to 18 percent average) and efficiency of feed utilization 5 to 15 percent (6 to 8 percent average). These increases, coupled with a relatively leaner carcass, make it imperative that a lamb feeder using relatively high-energy rations and young feeder lambs use DES in his feeding program. This fact has been well documented by Dr. R. L. Vetter and coworkers at Iowa State University (A.S. Leaflet R79, October 1965).

Briefly, let us look at each of the objections to the use of DES in lamb-finishing programs in order to determine the conditions under which the objection might be valid.

Difficult pelting. Reports from both Illinois (Sheep Day Report, 1959, p. 40) and Iowa (A.S. Leaflet R79) clearly indicate that a traction device or a skilled pelter can detect a stronger attachment of the pelt to the carcasses of treated lambs than of similar untreated lambs. This difference has not, however, reduced the value of carcasses in the packing plant. It is interesting to note (Table 1) that lambs fed a common soybean meal supplement were essentially as difficult to pelt as those lambs fed a urea-supplemented diet with DES.

"Water-belly." If urinary calculi are a problem, DES may aggravate the difficulty by increasing tissue growth near the urethra and possibly causing some constriction.

More "yearling" carcasses. If a lamb is nearing the age at which the breakjoint would normally solidify, DES may hasten the process, since lambs have been shown to retain a greater percentage of the ration calcium and nitrogen when under the influence of DES.

Higher cooler shrink. Shrink is a minor problem (see data in Iowa report, A.S. Leaflet R79). Presumably a carcass containing a higher ratio of lean to fat is desirable to meet current consumer tastes. Consequently, benefits outweigh any small differences in cooler shrink due to DES treatment.

Lower carcass grade. Carcass grades tended to be lower when former USDA specifications required a higher degree of fat in the choice grades. Table 1 shows that under present grading standards, when a high-energy ration is fed, DES need not lower carcass grade.

Increased rectal or vaginal prolapse. Prolapses have been largely associated with excessive treatments of DES. At present recommended levels, DES does not appear to increase prolapses above usual levels.

The sum of these observations strongly supports the use of DES at recommended dosages for finishing lambs because it produces faster and more economical gains in weight and the resulting carcasses meet present USDA grading standards.

Consumer acceptance of meat from DES-treated lambs has been reported by Hall and coworkers of Kansas in Food Technology 18 (1964), 886. They found no apparent differences in consumer acceptance of cooked, fresh, or frozen meat samples between DES-treated and control lambs.

The 3-milligram DES implants (which became relatively scarce during the past year) are now back on the market. On the basis of accumulated evidence, these implants, or 2 milligrams of DES per lamb per day in the feed, should be used by feeders who full-feed young, healthy lambs and use high-energy rations.

The increasing use of urea in lamb-finishing rations increases the need to use DES because the relative difference in performance of lambs fed urea-containing diets and those fed soybean meal-containing diets is greater with DES than without it (Table 1). Consequently, as more urea is fed, the benefits obtained from DES treatments become relatively more important to the feeder.

Table 1. Effect of Nitrogen Source and Diethylstilbestrol Implants and Their Interrelationship on Lamb Performance and Various Other Criteria[a/]

Treatment	No. of lambs	Average daily gain	USDA carcass grade score[b/]	Dressing percent[c/]	Pelting score[d/]	
					Fisting	Pulling
		lb.		(%)		
Soybean meal (SBM)[e/]	20	0.45	20.2	53.3	2.3*	1.7
Dehy-urea[e/]	20	0.46	20.0	52.8	1.8	1.7
Dehy-biuret[e/]	20	0.42	19.7	51.5*	1.7	1.6
Control	30	0.41	19.8	52.5	1.6	1.5
DES implant (3 mg.)	30	0.48**	20.2	52.5	2.3**	1.9
SBM	10	0.43	20.0	53.3	2.0	1.4
SBM + DES	10	0.47	20.4	53.3	2.5	2.0
Dehy-urea	10	0.40	19.7	52.5	1.4	1.5
Dehy-urea + DES	10	0.52	20.2	53.0	2.2	2.0
Dehy-biuret	10	0.39	19.6	51.7	1.3	1.5
Dehy-biuret + DES	10	0.46	19.9	51.3	2.1	1.7

a/ From Ph.D. Thesis, M. R. Karr, University of Illinois Library, Urbana, 1964.
b/ Low choice = 19; average choice = 20.
c/ Dressing percent = final weight off experiment ÷ chilled carcass weight.
d/ Easy = 1; normal = 2; difficult = 3.
e/ Self-fed mixed diet, 87 days. First 28 days, 47 percent cracked corn, 30 percent dehydrated ground corncobs, 5 percent cane molasses, 1 percent steamed bone meal, 0.5 percent trace-mineral salt, 0.5 percent aurofac (1.8 gm. chlortetracycline per pound), and 16 percent of soybean meal (50 percent C.P.) or 16 percent of dehy-urea (81 percent dehydrated alfalfa meal, 14 percent urea 262, and 5 percent cane molasses) or 16 percent dehy-biuret (80 percent dehydrated alfalfa meal, 15 percent pure biuret, and 5 percent cane molasses). Diets were changed after 28 days by increasing corn to 58 percent and reducing corncobs to 20 percent and protein supplement to 15 percent.

* $P < .05$.
** $P < .01$.

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AS-629b

EFFECTS OF SUPPLEMENTARY SULFUR AND DIETHYLSTILBESTROL (DES) ON ANIMALS FED A CORN SILAGE-CONCENTRATE-UREA DIET

J. S. Teuscher, U. S. Garrigus, B. B. Doane, and E. E. Hatfield

Much of the sulfur in livestock diets composed of forages, concentrates, and supplemental proteins is furnished in an organic form in the protein fraction of the diet. It has been demonstrated that whenever NPN compounds are used to replace part or all of the supplemental protein in the diet, the sulfur content may be marginal or inadequate. Theoretically, such deficiencies would become more critical under conditions of greater stress or under the stimulus of greater growth, which apparently can be sustained in ruminants by diethylstilbestrol.

This experiment was designed to:

1. Determine the effect of supplemental sulfur in a corn silage-concentrate-urea diet on gain of finishing lambs.

2. Determine the effect of DES on gain of animals fed a corn silage-concentrate-urea diet.

3. Evaluate the hypothesis that lambs will respond to supplemental sulfur in a corn silage-concentrate-urea diet when they are under the influence of DES.

Forty-eight white-faced Texas feeder lambs averaging 72 pounds were randomly divided into two replicated lots of 12 each and fed diets shown in Table 1. Water and trace-mineralized salt (essentially sulfur-free) were provided free choice. Six lambs in each lot were implanted with three milligrams of diethylstilbestrol at the beginning of the experiment. All lambs were fed twice daily an amount that would essentially equal ad libitum feeding for 54 days. Each lamb received a 500,000 IU injection of vitamin A at the beginning of the experiment.

Table 1. Composition of Diets

(Percent)

Ingredient	Diet	
	RF33	RF39
	Basal	Basal + Sulfur
	Lots 1 & 3	Lots 2 & 4
Corn silage, regular	75.00	75.00
Concentrate mixture		
Corn, ground	23.45	23.20
Limestone	0.50	0.50
Salt, trace-mineralized	0.25	0.25
Urea (262 C.P. equivalent)	0.80	0.80
Sulfur, elemental	0.00	0.25

The results of the experiment are shown in Table 2.

Table 2. Initial and Final Weights, Average Daily Gain, Feed Intake, and Feed to Gain (F/G) Ratio

Treatment	No. of lambs	Weight		Average daily gain	Average daily feed	(F/G) (DM basis)
		Initial	Final			
		lb.	lb.	lb.	lb.	lb.
Basal	24[a]	71.4	86.3	0.28	4.58	8.25
Basal + Sulfur	23[a]	70.8	85.7	0.28	4.53	8.17
No DES	24[a]	71.1	84.0	0.24[b]		
Plus DES	23[a]	71.0	88.1	0.32[b]		
Basal	12	70.3	84.3	0.26		
Basal + DES	12	72.4	88.4	0.30		
Basal + Sulfur	12[a]	71.8	83.7	0.22[b]		
Basal + Sulfur + DES	11[a]	69.5	87.8	0.34[b]		

a/ One lamb exhibited abscess near end of experiment, and its data are not included.
b/ $P < .01$.

Summary

Data in Table 2 show no response in lambs not implanted with DES whenever supplementary sulfur was added to the basal corn silage-concentrate-urea diet.

Gains in the DES-implanted lambs were significantly ($P < 0.01$) greater than those in the nonimplanted lambs.

The interaction between sulfur and DES was significant ($P < 0.05$). Gains of the DES-implanted lambs that received supplemental sulfur in the diet were 55 percent greater than gains of the nonimplanted lambs receiving the basal diet not supplemented with additional sulfur.

Chemical analyses show that, in general, both corn and corn forage contain a rather low level of sulfur. These results, together with evidence of favorable gain responses to sulfur supplementation by animals implanted with DES and receiving a corn silage-concentrate-urea diet, suggest that the basal diet was low in total or available sulfur. These observations support the recommendation that sulfur should be added to corn silage-concentrate diets, especially when NPN compounds are used to replace the supplemental protein.

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STUDY OF VARIOUS SUPPLEMENTARY NITROGEN SOURCES WHEN ENSILED WITH HIGH-CONCENTRATE SILAGES

J. S. Teuscher, U. S. Garrigus, B. B. Doane, and E. E. Hatfield

This experiment was designed at the Illinois Station to study various sources of supplementary nitrogen in completely ensiled diets. The sources of supplementary nitrogen were urea, biuret, urea-alfalfa mixture, soybean meal, and diammonium phosphate.

The following diets were mixed by recycling several times in a self-unloading wagon and were then ensiled in wooden stave silos (Table 1).

Table 1. Silage Composition and Diet

Silage composition	Diet					
	RF18	RF19	RF20	RF21	RF22	RF23
	lb.	lb.	lb.	lb.	lb.	lb.
Corn fodder, chopped	1,500	1,500	1,500	1,500	1,500	1,500
Corn, ground	485	469	467	385	385	449
Limestone	10	10	10	10	10	10
NaCl, TM	5	5	5	5	5	5
Urea-262	--	16	--	--	14	--
Biuret	--	--	18	--	--	--
Ammonium phosphate, dibasic	--	--	--	--	--	36
Soybean meal (50% C.P.)	--	--	--	100	--	--
Alfalfa meal (17% C.P.)	--	--	--	--	81	--
Molasses	--	--	--	--	5	--
Total	2,000	2,000	2,000	2,000	2,000	2,000

Western feeder lambs were used as test animals. After the lambs had been processed (shorn, weighed, identified with ear tags, dipped, drenched for internal parasites, vaccinated for contagious ecthyma, placed in drylot for a few days, and fed good-quality hay to allow recovery from shipping fatigue), they were placed on an adjusting diet consisting of regular corn silage and ground corn.

After two weeks on the adjusting diet, the lambs were randomly assigned to the experimental diets and were placed in metabolism cages. Three nitrogen balance studies, starting on the 6th, 13th, and 41st days, were made on lambs on each of the experimental diets. The feed was carefully weighed and was limited to the amount consumed within two hours after it had been offered. Daily diet samples were taken for a composite sample to represent each collection period.

The results of the study are shown in Table 2.

Table 2. Digestibility and Nitrogen Balance Data

	Diet					
	RF18	RF19	RF20	RF21	RF22	RF23
Supplemental N	None	Urea	Biuret	Soybean meal	Urea-dehy	Diammonium phosphate
Diet dry matter, %	48.3	47.2	47.4	45.0	44.6	50.3
Dry matter intake, gm. per day	825	799	824	720	690	719
Diet nitrogen, % dry matter	1.51	2.10	2.06	2.12	1.77	1.88
Diet crude protein, % dry matter	9.4	13.1	12.9	13.2	11.1	11.8
Apparent digestibility						
Dry matter	74.7	79.7	74.7	83.0	72.5	75.6
Nitrogen	67.6	74.0	71.0	68.4	65.6	68.0
N balance, gm. per day	4.11	4.76	4.51	3.94	2.74	3.65
N retained per 100 gm. dry matter, mg.	499	597	548	549	390	505

Discussion

The acceptability of the unsupplemented diet (RF18) was relatively high, and the performance of animals receiving it was comparatively good. The crude protein level was 9.40 percent, which was slightly higher than anticipated in unsupplemented diets formulated from corn fodder and corn. Except for the supplementary nitrogen sources, all diets were prepared from the same ingredients.

Although acceptability and performance of animals receiving diet RF18 were good, calculations suggest that efficiency of nitrogen storage in animals receiving it was below that in animals receiving diets RF19, RF20, and RF21. These calculations were based on assumptions of the same degree of performance at lower intakes as at higher intakes. Therefore such calculations would tend to penalize the diets consumed at lower levels, since maintenance requirements for nitrogen are met before a positive balance can be indicated. The bottom line in Table 2 shows the calculated amount of nitrogen retained per 100 grams of dry matter consumed.

The performance of animals on diet RF22 (supplemented with a combination of urea and alfalfa) was below that of animals on the other diets. Its acceptability was the lowest of any of the diets. Chemical analysis of RF22 samples taken during the balance studies showed a lower nitrogen level than in the other nitrogen-supplemented diets.

These data suggest that either urea alone or biuret is a satisfactory source of nitrogen for supplementing high-energy corn silage diets when ensiled as a complete feed.

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CHEMICAL CHARACTERISTICS OF SUPPLEMENTED SILAGE

I. M. Brookes, G. T. Schelling, J. S. Teuscher, E. E. Megli, and E. E. Hatfield

The effects of supplementing fresh chopped corn fodder and corn silage on final chemical characteristics were determined.

Table 1. Composition of the Diets (Percent)

Ingredient	Diet					
	RF33	RF34	RF35	RF36	RF37	RF38
Corn silage, regular	75.00					
Corn, ground	23.45					
Limestone	0.50					
NaCl, trace-mineralized	0.25					
Urea, 262	0.80					
Urea-corn mixture (50% C.P.)					5.00	-
Soybean meal (50% C.P.)					-	5.00
Ensiled						
Corn, fodder, chopped		75.00	75.00	75.00	(95.00	(95.00
Corn, ground		24.25	23.45	19.25	of RF34)	of RF34)
Limestone		0.50	0.50	0.50		
NaCl, trace-mineralized		0.25	0.25	0.25		
Urea, 262		-	0.80	0.70		
Alfalfa meal		-	-	4.05		
Molasses		-	-	0.25		
Free-choice mineral[a/]	+	+	+	+	+	+

a/ Trace-mineralized salt, 50%; dicalcium phosphate, 50%.

Samples of fresh forage were taken as the silos were being filled. Remaining samples were obtained periodically at time of feeding.

A summary of chemical characteristics is shown in the following tables:

Table 2. Approximate Analysis, Percent of Dry Matter

Sample	Fresh chopped corn fodder	Regular corn silage	Diet					
			RF33	RF34	RF35	RF36	RF37	RF38
Dry matter	40.3	32.2	45.5	50.3	50.1	45.6	52.3	52.4
Crude protein	7.8	6.9	9.8	7.8	11.3	13.3	9.5	9.8
Ether extract	2.9	2.7	3.2	3.3	3.9	3.7	3.4	3.2
Crude fiber	19.9	24.5	19.0	11.7	11.7	14.4	11.2	11.3
Nitrogen-free energy	65.2	60.5	63.0	72.8	69.0	62.4	71.6	71.2
Ash	4.2	5.4	5.0	4.4	4.1	5.2	4.3	4.5

Table 3. Chemical Characteristics

	Fresh chopped corn fodder	Regular corn silage	Diet					
			RF33	RF34	RF35	RF36	RF37	RF38
Supplementary energy	None	None	At feeding	Ensiled	Ensiled	Ensiled	Ensiled	Ensiled
Supplementary N	None	None	Urea at feeding	None	Urea ensiled	Urea-dehy ensiled	Urea at feeding	Soybean meal at feeding
pH	5.70	3.85	4.45	4.12	4.81	5.21	4.46	4.60
S.D.A.[a/]	None	3.46	2.85	4.15	4.14	5.16	4.17	4.15
NH_3-N[b/]	None	2.20	2.10	4.50	23.50	18.70	4.20	2.40
Urea-N[b/]	None	None	32.40	3.20	6.50	5.80	30.80	None

a/ Steam-distillable acids (milliequivalent (mEq.) acid per 50 milliliter).
b/ Ammonia nitrogen and urea nitrogen were determined from a 500-milliliter extract from 50-gram samples and expressed as milligrams per 100-milliliter extract.

It was noted that in RF33 and RF37, in which urea was added at feeding, the nitrogen was recovered as urea-nitrogen. However, in RF35, where the same level of urea was used and ensiled, only part of the nitrogen was recovered as urea-nitrogen, but the ammonia nitrogen accounted for most of the difference. The percent of recovery of urea-nitrogen was the same in RF36, which contained a lower level of urea than RF35.

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AS-629e

EFFECT OF ENSILING ENERGY AND/OR NITROGEN SUPPLEMENTS WITH CORN SILAGE

E. E. Hatfield, F. C. Hinds, J. S. Teuscher, and U. S. Garrigus

Should corn silage rations be formulated at time of harvest or at time of feeding? Although many questions have been raised concerning time for formulating corn silage rations, convenience and economics at either time of harvest or time of feeding may vary and affect decisions. However, more data are needed regarding acceptability, nutritive losses, and performance of animals on ensiled complete rations.

This experiment was designed to study:

1. Source of supplementary nitrogen,
2. Effect of ensiling supplementary nitrogen,
3. Effect of ensiling supplementary energy, and
4. Influence of diet, stage of growth, and time of administration of vitamin A on liver storage of vitamin A.

One hundred forty-four feeder lambs averaging 75 pounds were used. Twelve lambs were selected at random and sacrificed on test day 1 to determine the initial liver storage of vitamin A. The remaining 132 lambs were randomly assigned to treatments shown in Table 1.

Table 1. Design of Experiment (Number of Lambs)

	Diet											
	RF33		RF34		RF35		RF36		RF37		RF38	
	C	T[a]	C	T	C	T	C	T	C	T	C	T
Sacrificed on day												
9	2	2	2	2	2	2	2	2	2	2	2	2
18	2	2	2	2	2	2	2	2	2	2	2	2
36	2	2	2	2	2	2	2	2	2	2	2	2
72	2	2	2	2	2	2	2	2	2	2	2	2
Vitamin A given on day												
36 (36) b/	2		2		2		2		2		2	
54 (18) c/	2		2		2		2		2		2	
63 (9) d/	2		2		2		2		2		2	

a/ C = control; T = treated (vitamin A).
b/ Vitamin A storage for last 36 days to be compared with storage for first 36 days.
c/ Vitamin A storage for last 18 days to be compared with storage for first 18 days.
d/ Vitamin A storage for last 9 days to be compared with storage for first 9 days.

The composition of the test diets is shown in Table 2.

Table 2. Composition of the Diets (Percent)

Ingredient	Diet					
	RF33	RF34	RF35	RF36	RF37	RF38
Corn silage, regular	75.00					
Corn, ground	23.45					
Limestone	0.50					
NaCl, trace-mineralized	0.25					
Urea, 262	0.80					
Urea-corn mixture (50% C.P.)					5.00	-
Soybean meal (50% C.P.)					-	5.00
Ensiled						
Corn, fodder, chopped		75.00	75.00	75.00	(95.00	(95.00
Corn, ground		24.25	23.45	19.25	of RF34)	of RF34)
Limestone		0.50	0.50	0.50		
NaCl, trace-mineralized		0.25	0.25	0.25		
Urea, 262		-	0.80	0.70		
Alfalfa meal		-	-	4.05		
Molasses		-	-	0.25		
Free-choice mineral[a/]	+	+	+	+	+	+

a/ Trace-mineralized salt, 50%; dicalcium phosphate, 50%.

The lambs were fed twice daily more of the respective diets than they could completely consume between offerings. Periodic weighbacks of refused feed were made and recorded. The results of the data are summarized in Table 3.

Summary

The best performance was obtained from lambs receiving RF38, which had been supplemented with an energy source at time of ensiling and with soybean meal at time of feeding. All of the urea-supplemented diets gave significantly better performance than RF34, to which an energy source had been added at ensiling, but no nitrogen supplement. Comparing performance of lambs receiving diets RF33, RF35, and RF37 suggests that adding the supplementary energy source at ensiling may significantly affect the performance of animals receiving NPN supplementation.

These data demonstrate again that urea nitrogen is a useful source of supplementary nitrogen for ruminants but may be affected by other components in the diet.

Table 3. Summary of Observations

	Diet					
	RF33	RF34	RF35	RF36	RF37	RF38
Energy supplement	At feeding	Ensiled	Ensiled	Ensiled	Ensiled	Ensiled
Nitrogen supplement and formulation time	Urea at feeding	None	Urea ensiled	Urea-dehy ensiled	Urea at feeding	Soybean meal at feeding
Average daily gain,[a/] lb.	0.23	0.19	0.29	0.27	0.32	0.38
Average daily feed, lb.	4.49	4.20	4.49	4.61	4.34	4.44
Average daily feed, DM, lb.	2.04	2.11	2.25	2.10	2.27	2.33
Feed-to-gain ratio, lb.	9.93	12.53	8.71	8.67	7.88	6.87
Dressing percentage	49.6	48.9	48.5	49.1	50.9	50.0
Carcass grade (P = 10, C = 9, G = 8)	8.8	8.6	8.5	8.6	9.0	8.8

a/ Statistical significance of differences in average daily gain:

Time of energy supplementation: RF33 versus RF37--$P < 0.01$.

Time of nitrogen supplementation: RF33 versus RF35--$P < 0.05$.

Source of nitrogen: All nitrogen supplements versus RF34--$P < 0.01$.
RF38 versus all urea-supplemented diets--$P < 0.01$.
RF35 versus RF36--N. S.

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EFFECT OF DIETHYLSTILBESTROL IMPLANTS ON THE PERFORMANCE OF EARLY-WEANED LAMBS (20-343)

J. M. Lewis, F. C. Hinds, and M. E. Mansfield

Results have been reported to indicate that diethylstilbestrol (DES) implants improve the rate and efficiency of gain of feeder lambs 150 days of age or older. However, research has not shown a similar improvement in performance when the treatment was used on suckling lambs. Thus this report covers a study of the effects of DES implants on both ewe and ram lambs that had been weaned at a relatively early age.

Procedures

Two tests were conducted at the Dixon Springs Agricultural Center, Simpson, Illinois, to study the effects of DES implants on early-weaned lambs. Fall-born lambs sired by Suffolk rams and out of Suffolk, Targhee, and western black-faced ewes were used in the first trial. Lambs were weaned January 6, 1965, when they varied in age from 56 to 79 days, the average being 70.6 days. The lambs were divided by sex and origin and randomly allotted to four lots of eight each. Replicate lots were self-fed one of the two rations listed in Table 1. Four lambs in each lot were implanted with 3 milligrams of DES two weeks after they had been weaned. They were confined to a 12- by 40-foot pen in an open shed and were self-fed. Water and mineral were available free choice.

Table 1. Diet, Self-Fed, Winter, 1965

Ingredient	Soybean meal	Dehy-urea
	lb.	lb.
Corn, ground shelled	590	590
Hay, ground mixed	250	250
Soybean meal (50% C.P.)	160	--
Dehy-urea[a] (50% C.P.)	--	160
Bone meal	10	10
Limestone	10	10
Salt	5	5
Premix[b]		

a/ P1 supplement, in pounds: alfalfa, dehydrated (17% C.P.), 30; urea (262% C.P.), 14; molasses (cane), 5; and dicalcium phosphate, 1.

b/ Vitamin A to equal 1,000 IU per pound of ration; vitamin D to equal 400 IU per pound of ration; terramycin (TM-10) at 10 milligrams per pound of ration.

The second study involved 64 lambs that were born late in the spring of 1965. They were sired by Suffolk rams and out of Suffolk, Targhee, and southwestern white-faced ewes. The lambs were divided by sex and origin and randomly

allotted to eight lots of eight each and used in a space requirement study. They were confined to elevated slotted floors and were self-fed the high-energy, high-protein ration shown in Table 2. Mineral and water were available free choice.

Table 2. Complete High-Energy Diet, Self-Fed, Summer, 1965

Ingredient	Pound
Corn, ground shelled	48.5
Hay, ground mixed	25.0
Soybean meal (50% C.P.)	25.0
Limestone, feeding grade	1.0
Salt	0.5
Premix[a/]	

a/ Vitamin A to equal 1,000 IU per pound of ration; vitamin D to equal 400 IU per pound of ration; terramycin (TM-10) at 10 milligrams per pound of ration.

Two wether lambs and two ewe lambs from each lot were implanted with 3 milligrams of DES when they were approximately 100 days of age. Individual weight data were collected periodically on all lambs in both trials; however, feed consumption data by treatment could not be collected, since implanted and control lambs were housed together in both trials. The gain data were analyzed by analysis of variance.

Results and Discussion

Data collected in the first trial are listed in Table 3. A significant increase in gains resulted from use of 3-milligram DES implants. Implanted lambs fed the ration containing soybean meal gained 14.2 percent faster than the control lambs. Implanted lambs receiving dehy-urea gained 28.6 percent faster than the controls, suggesting that there may have been some interaction due to source of nitrogen. This observation is in general agreement with reports by Karr et al. (1964).[1/]

Table 3. Effect of Diethylstilbestrol Implants on Performance of Early-Weaned Lambs

Treatment	No. of lambs	Days on trial	Weight		Average daily gain
			Initial	Final	
			lb.	lb.	lb.
Soybean meal	8	54	69.4	106.4	0.685
Soybean meal + DES, 3 mg.	8	54	64.9	107.1	0.782
Dehy-urea	8	54	57.5	92.4	0.646
Dehy-urea + DES, 3 mg.	8	54[a/]	62.0[a/]	106.8[a/]	0.831

a/ Data for 7 lambs; one lamb removed March 1, vaginal and rectal prolapse.

1/ Karr, M. R., U. S. Garrigus, E. E. Hatfield, and H. W. Norton. 1965. Factors affecting the utilization of nitrogen from different sources by lambs. J. Animal Sci. 24:459.

One implanted ewe lamb was removed from the experiment on February 28, 29 days after receiving the DES implant, because of a vaginal and rectal prolapse. This was the only serious side effect attributed to the use of DES implants.

Data collected in the second trial involving 64 lambs are presented in Table 4. These lambs were all self-fed a complete ration containing soybean meal. The implanted lambs gained significantly faster (0.528 pound average daily gain) than the control lambs (0.467 pound average daily gain). The increase of 13.1 percent compares very well with the 14.2 percent increase shown by the implanted lambs receiving a similar ration during the winter feeding trial. The data also indicate a highly significant interaction between DES and sex of lambs, as the ewe lambs appeared to show a greater response to DES than the wether lambs. No adverse side effects were noted in the second trial.

Table 4. Lamb Gain Data (Pounds)

Treatment	No. of lambs	Days on trial	Weight		
			Initial	Final	Average daily gain
			lb.	lb.	lb.
Control	30[a/]	55	59.8	85.5	0.467
DES implant, 3 mg.	32	55	56.5	85.6	0.528

a/ Two originally allotted lambs died.

Summary

The results show that a 3-milligram diethylstilbestrol implant is effective in promoting gains in early-weaned lambs.

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INFLUENCE OF A DIETARY SUPPLEMENT OF B-VITAMINS ON THE PERFORMANCE OF EARLY-WEANED LAMBS

F. C. Hinds, M. E. Mansfield, and J. M. Lewis

During recent years, research at the Illinois Agricultural Experiment Station, Urbana, and the Dixon Springs Agricultural Center, Simpson, Illinois, has been designed to study the nutritional needs of young, rapidly growing weaned lambs. As progress is made toward intensifying lamb production, it is also necessary to define as precisely as possible the nutritional requirements of young lambs for maximum growth. This need arises from the fact that maximum growth is necessary for maximum efficiency and there is no previous research from which to develop scientifically sound requirements. The results reported here summarize four years' study of the value of supplementing the diets of lambs weaned at six weeks of age with a B-vitamin supplement.

Experimental Procedure

In the 1962 study, 24 lambs of similar breeding (Suffolk and Targhee rams and northwestern black-faced ewes) were weaned, weighed, and placed on two test rations at approximately six weeks of age. The diets and treatments are shown in Table 1.

Table 1. Diets

	EW8	EW9
Hay, ground, lb.	250	250
Corn, yellow shelled, ground, lb.	606	606
Soybean meal, 50% C.P., lb.	119	119
Bone meal, lb.	10	10
Limestone, lb.	10	10
Salt, lb.	5	5
Vitamin A[a/]	+	+
TM-10[b/]	+	+
B-vitamins[c/]	+	0

a/ To provide 1,000 IU of vitamin A per pound of ration.
b/ To provide 10 milligrams of terramycin activity per pound of ration.
c/ To provide 1 gram of riboflavin, 15 grams of niacin, 5 grams of pantothenic acid, 100 grams of choline, and 15 milligrams of vitamin B_{12} per ton of ration.

Both rations were pelleted and self-fed; and a salt-mineral mix and water were available. All male lambs had been castrated and all lambs docked at 14 to 21 days of age. None of the lambs were drenched or vaccinated against enterotoxemia. Both lots were housed in the same open, pole-type shed.

In the studies conducted in 1963, 1964, and 1965, purebred Hampshire lambs from the same parent stock were weaned, weighed, and placed on test at approximately six weeks of age. Diets and treatments are shown in Table 1. The rations were in meal form and were self-fed, and a salt-mineral mix and water were available. In most cases the males were left intact; where some were castrated at 14 to 21 days of age (1965), the castrated and the intact were divided between the two treatments. None of the lambs were drenched or vaccinated against enterotoxemia. All lambs were maintained on elevated slotted floors throughout the study.

In all four years the lambs had access to a creep containing the control ration from about seven days of age on. Weights were usually taken at weekly intervals.

The data were analyzed by using the t-test.

Fecal samples were obtained periodically for examination for gastrointestinal-nematode eggs.

Table 2. Four-Year Summary of Performance of Early-Weaned Lambs Fed Supplemental B-Vitamins

	No. of lambs	Average initial weight	Average days on study	Average daily gain	Feed per pound gain	Average daily feed intake
		lb.		lb.	lb.	lb.
Control	11	34.4	49	0.41	4.7	1.8
1962 + B-vitamins	12	34.5	50	0.46	3.9	1.8
Control	5	34.6	52	0.59	3.7	2.2
1963 + B-vitamins	5	33.6	52	0.71	3.5	2.5
Control	6	42.7	64	0.58	4.4	2.5
1964 + B-vitamins	6	34.0	63	0.60	4.2	2.5
Control	8	35.5	41	0.72	3.2	2.3
1965 + B-vitamins	8	37.2	41	0.68	3.2	2.2

Results and Discussion

The results obtained during the past four years are presented in Table 2. In general, the average initial weights were similar throughout the studies. Statistical analysis of gain data indicated that the average daily gains of lambs receiving the control diet and the B-vitamin-supplemented diet did not differ significantly. However, there appears to have been a consistent trend (three of four

years) in average daily gain favoring those lambs on the diet supplemented with B-vitamins. As would be expected, the amount of feed required per pound of gain generally decreased as rate of gain increased. Since the lambs were self-fed in groups, the feed data cannot be statistically analyzed. It is interesting to note that daily feed intake did not greatly differ between treatments. Examination of the fecal samples indicated no gastrointestinal-nematode eggs. It would be dangerous to compare lamb performance in different years because of the differences in length of time on study and the effect of different climatic conditions from year to year.

The foregoing studies suggest that, with the diets that were used, supplemental B-vitamins were of limited, if any, benefit. However, as the control diet is modified either to decrease the amount of B-vitamins naturally present in the diet (by decreasing hay and increasing grain) or to increase the rate of gain as well as the feed intake of lambs, the need for B-vitamins may increase. Under such conditions the response to added B-vitamins could be greater than is reported here. It appears that a more precise approach (individual feeding and/or metabolism studies) is needed to determine accurately whether and where supplemental B-vitamins are needed in diets for early-weaned lambs.

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INFLUENCE OF LEVEL OF DIETARY NITROGEN AND SUPPLEMENTED AMINO ACIDS ON THE GROWTH AND NITROGEN UTILIZATION OF EARLY-WEANED LAMBS

F. C. Hinds, E. E. Hatfield, and B. B. Doane

Results of studies conducted at the Dixon Springs Agricultural Center, Simpson, Illinois, on the protein requirements of early-weaned lambs showed the protein requirement for young lambs to be from 18 to 19 percent of the diet. These studies were conducted over a four-year period. In describing protein requirements, it is advisable to use data from studies on the efficiency of nitrogen utilization by the animal in addition to that obtained from growth studies.

The study reported here was designed to determine the level of a combination of corn and soybean meal protein that would promote maximum gains and nitrogen retention in young, growing lambs and to determine whether the young ruminant would respond to a dietary supplement of amino acids.

Procedure

During the spring of 1964, sixty-four crossbred lambs were weaned at an average age of 73 days and used in a 4 x 2 x 2 x 2 factorial arrangement of treatments (see Table 1). The factors to be studied were level of crude protein (4), amino acid supplementation (2), sex of lamb (2), and type of birth (2).

Table 1. Design of Study

	Treatment							
	1		2		3		4	
Amino acids	0	+	0	+	0	+	0	+
Protein level	14.3	--	16.4	--	19.4	--	22.4	--
	--	14.6	--	17.2	--	19.9	--	22.7
No. of lambs	8	8	8	8	8	8	8	8

Average weaning age, 73 days.
Days on study, 70.

The experiment had two phases. Phase 1 consisted of a growth study during which the lambs were individually penned and fed once daily. The diets are shown in Table 2. Feed was offered in larger amounts than each lamb would eat in 24 hours, and refusals were collected daily. Nitrogen levels in the diets were varied by replacing corn with soybean meal and corn gluten meal in such proportions that the amount of nitrogen from corn products and soybean meal remained constant. In one of the two groups at each of the four levels of dietary nitrogen, lysine and DL-methionine were both added at 0.080 and 0.032 percent of the diet, respectively. The roughage was cellulose, and a complex mineral and vitamin

Table 2. Composition of Diet (Percent)

Ingredient	Diet 1	2	3	4
Corn, ground	53.9	45.4	37.1	28.6
Soybean meal (50% C.P.)	17.3	20.8	24.2	27.7
Starch	3.8	4.6	5.3	6.1
Corn gluten meal	0.0	4.2	8.4	12.6
Solka floc	15.0	15.0	15.0	15.0
Minerals	4.0	4.0	4.0	4.0
Glucose	4.0	4.0	4.0	4.0
Vitamins and AA mix	2.0	2.0	2.0	2.0

supplement (Table 3) was included in the diets. All males were intact, and all lambs were docked at an early age. None of the lambs were drenched or vaccinated against enterotoxemia. All lambs had been provided with a creep ration for about two months prior to weaning. Slaughter and wool data were collected initially and finally on a representative sample of each treatment, but these data are not included in this report.

Table 3. Vitamin and Antibiotic Levels

Vitamin A, IU per kg.	3,308
Vitamin D_2, IU per kg.	309
Vitamin E, IU per kg.	88
Riboflavin, mg. per kg.	1
Pantothenic acid, mg. per kg.	5
Niacin, mg. per kg.	16
Choline, mg. per kg.	127
B-12, mcg. per kg.	57
Chlorotetracycline, mg. per kg.	40

Phase 2 began after at least two lambs from each of the eight dietary treatments had been on their respective diets 28 days, at which time they were placed in metabolism units. After a seven-day adjustment period in the units, there was a seven-day collection period during which total collections were made of feces and urine. Following the first group, a second group of 16 lambs was used to complete the metabolism study.

All of the data were analyzed by least-squares analysis.

Results and Conclusions

Data on the performance of the lambs during the growth study are presented in Table 4. In these studies protein had no significant effect on gain or feed required per pound of gain. Also, the dietary supplement of lysine and methionine had no significant effect on lamb performance.

Table 4. Lamb Performance During Growth Study

Treatment No.	Diet C.P.	Initial weight	Average daily gain	Daily feed	Feed-to-gain ratio	Daily feed as percent of weight
	%	lb.	lb.	lb.	lb.	%
1	14.3	42.5	.500	2.65	5.29	4.4
2	16.4	37.0	.527	2.40	4.58	4.3
3	19.4	39.5	.536	2.53	4.74	4.4
4	22.4	39.2	.540	2.60	4.84	4.5
+AA						
1	14.6	37.7	.456	2.23	4.86	4.1
2	17.2	40.1	.547	2.47	4.52	4.2
3	19.9	40.8	.478	2.45	5.10	4.2
4	22.7	39.2	.500	2.29	4.61	4.0

Although the differences observed between treatments in rate of gain and feed per pound of gain were not statistically significant, rate of gain increased with increasing levels of dietary protein when amino acids were not added. Also, the drop in feed required per pound of gain as the level of dietary protein increased from 14.3 to 16.4 represented a substantial change. It is our feeling that the observations are biologically significant, and yet they cannot be compared with previous work reported from this Station largely because of the major change made in the roughage component of the diets. Although data are not presented on the liver vitamin A status of these lambs, liver samples were collected at slaughter and vitamin A analyses were run on duplicate samples. The results show no effect from any of the treatments; the values were within the normal range, suggesting that the vitamin A supplementation was adequate.

Information on the digestibility of components in the rations is presented in Table 5. These data are interesting in that they show a significant linear effect of level of dietary protein and a significant effect of amino acid additions on both dry matter and nitrogen digestibility. These results are difficult to explain, but they are similar to those obtained by British workers with early-weaned calves. It is apparent that all of the diets were highly digestible and, as shown in Table 4, readily consumed.

Table 6 presents data on nitrogen utilization. Again, level of dietary protein had a significant linear effect on daily nitrogen balance. Amino acid supplementation did not affect the amount of nitrogen that was retained. The increase in nitrogen balance due to increased dietary protein was to be expected in view of the increase in gain obtained during the growth study. The values for retained nitrogen are higher than might be expected from older lambs, but these are the first nitrogen balance data obtained on young lambs and, until further work is done, they are the only information that is available. The data, expressed as grams of nitrogen retained per kilogram of body weight to the 3/4 power, agree closely with data obtained by the previously mentioned British workers. It will

Table 5. Dry Matter, Nitrogen, and Energy Digestibility

Treatment No.	Diet C.P.	Dry matter	Nitrogen	Digestible protein	Digestible energy[a/]
	%	%	%	%	%
1	14.3	71.8	75.3	10.8	74.8
2	16.4	75.6	80.3	13.2	78.9
3	19.4	74.8	81.5	15.8	77.4
4	22.4	77.5	84.4	18.9	80.1
+AA					
1	14.6	76.7	77.8	11.7	80.3
2	17.2	77.6	81.7	14.0	81.0
3	19.9	77.5	84.4	16.8	80.3
4	22.7	76.9	85.2	19.4	79.2

a/ Calculated from digestible dry matter.

Table 6. Daily Nitrogen Balance and Energy Intake

Treatment No.	Diet C.P.	Nitrogen balance	Nitrogen per kilogram weight$^{3/4}$	Digestible energy intake	Digestible energy per percent digestible protein
	%	gm.	gm.	KCal.	%
1	14.3	9.96	0.69	3,790	6.94
2	16.4	11.14	0.79	3,645	5.98
3	19.4	13.48	0.94	3,801	4.89
4	22.4	15.26	1.06	4,056	4.24
+AA					
1	14.6	9.19	0.68	3,432	6.84
2	17.2	12.04	0.84	3,855	5.77
3	19.9	12.70	0.91	3,815	4.77
4	22.7	13.99	1.00	3,544	4.09

be interesting to study the slaughter data to see whether it reflects this increase in retained nitrogen. Although not reported in tabular form, data on blood urea levels indicate no apparent difference in this value due to level of dietary protein. This result suggests that nitrogen in the form of blood urea was not accumulating.

Data on digestible energy are presented to provide an estimate of the optimal protein-to-energy ratio for growth in young lambs. The results suggest that a ratio of percent of digestible energy to percent of digestible protein of 5 to 6 is best, considering both gain and feed required per pound of gain.

In conclusion, the data presented do not disagree with data previously presented describing the protein needs of young lambs. Additional research will no doubt clarify the picture, but at present it seems that the previous recommendation of including 17 to 19 percent protein in the diet is sound for young, rapidly growing lambs fed a high-concentrate corn, soybean-meal-type diet.

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AS-629i

STUDIES OF AMINO ACID METABOLISM IN THE RUMINANT

G. T. Schelling and E. E. Hatfield

The fact is well recognized that a large portion of the amino acids absorbed by a ruminant come from the digestion of microbial protein. This protein is formed as a result of utilization of dietary nitrogen sources by the microbes to form amino acids, which are subsequently incorporated into the protein. Thus the quality of the protein (that is, amino acid composition) provided to the host animal tends to be consistent, while the quality of the dietary protein may vary considerably. This concept brings up the question whether the quality of microbial protein is optimum for the ruminant.

The examination of blood constituents is often a useful method of studying the utilization of a nutrient. Plasma amino acid concentrations can perhaps be used to detect amino acid deficiencies. However, because of the dynamic condition of the blood, plasma concentrations are difficult to interpret without some knowledge of the rate of metabolism of the specific nutrient in question.

Radioactive materials provide a convenient tool for studying the metabolism rate and pool size of nutrients and other biological components. The half-life of a substance--for example, the amino acid lysine--is the time required for half of the lysine to be removed from the "pool." The pool represents the amount of the lysine in rapid equilibrium with the medium sampled. The half-life can be determined experimentally in blood by giving the animal an intravenous dose of radioactive lysine and thereafter periodically taking blood samples to determine the amount of radioactive lysine that remains. Another value that is often used is the turnover time, which is the time required for an amount of lysine equal to the total amount in the pool to be removed from the pool. This value is equal to

$$\frac{\text{Half-life}}{\text{Natural logarithm 2}}$$

The turnover rate is the amount of lysine being removed from the pool per unit of time. This rate is determined by constantly infusing a certain amount of radioactive lysine per unit of time and determining the amount of radioactivity per unit of lysine in the pool after equilibrium has been reached. The turnover rate is equal to

$$\frac{\text{Infusion rate (radioactivity per unit of time)}}{\text{Radioactivity per unit of lysine in the pool}}$$

In our preliminary work ^{14}C uniformly labeled L-lysine was used to estimate the half-life of lysine in the plasma of growing sheep. A single injection of ^{14}C lysine was administered intravenously, and blood samples were collected periodically thereafter. The results of the preliminary studies suggested that the rate of lysine metabolism was rapid--as indicated by the length of the half-life and turnover time. A considerable amount of ^{14}C from lysine also appeared to be rapidly incorporated into other amino acids. Examination of the plasma protein showed that large amounts of ^{14}C were incorporated into these proteins. The half-life of the plasma proteins appeared to be greater than five days.

With the preliminary studies as guidelines, further studies are now under way to determine the rate of metabolism and the metabolic pathways of lysine in the ruminant.

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AS-629j

FLOOR SPACE REQUIREMENTS OF LAMBS CONFINED TO ELEVATED SLOTTED FLOORS (20-343)

J. M. Lewis, F. C. Hinds, and M. E. Mansfield

In 1964 at the Dixon Springs Agricultural Center, Simpson, Illinois, a limited number of early-weaned lambs were confined to elevated slotted floors in a floor-space requirement study. This study, which involved two treatments (four and eight square feet per lamb), was reported in the 1964 Sheep Day Report. No significant difference was noted in performance of lambs as measured by rate of gain and feed efficiency.

In 1965, a 2 x 2 x 4 factorial experiment was designed to further test the minimum floor-space requirements of early-weaned lambs when confined to elevated slotted floors and fed a high-energy ration during hot, humid summers typical of southern Illinois.

Table 1. Complete High-Energy Diet, Self-Fed, Summer, 1965

Ingredient	Pound
Corn, ground shelled	48.5
Hay, ground mixed (legume and grass)	25.0
Soybean meal (50% C.P.)	25.0
Limestone feeding grade	1.0
Salt	0.5
Premix[a/]	

a/ Vitamin A to equal 1,000 IU per pound of ration; vitamin D to equal 400 IU per pound of ration; terramycin (TM-10) at 10 milligrams per pound of ration.

Procedure

Four floor-area allotments were studied: four, six, eight, and ten square feet per lamb. Sixty-four lambs ranging in age from 65 to 144 days, sired by Suffolk rams and out of Targhee and southwestern white-faced ewes, were divided by sex and origin and randomly assigned to one of eight lots with eight lambs per lot. Replicate lots were assigned to each of the four floor spacings. Half of the lambs in each lot were implanted under the skin of the left ear with 3 milligrams of diethylstilbestrol. A complete high-energy ration listed in Table 1 was self-fed in metal feeders designed for swine. Water and a mineral mixture were available free choice. Self-feeders, mineral boxes, and water fountains were placed outside of wooden panels that surrounded the slotted floors. The floors were built of 4- by 5-foot steel grids with 1 1/2-inch slats, and 5/8-inch openings. Floors were erected approximately two feet off the ground in two groups of four adjacent pens. Lambs were assigned to floors so that each treatment was represented by an end pen (one with three outside panels) and by an inside pen. Gain data and feed consumption were recorded. Overheating and other abnormal conditions were noted. Data were collected for the period from June 25 to August 19. The gain data were analyzed by analysis of variance.

Results and Discussion

Data reflecting the effect of floor space on animal gains and feed conversion are presented in Table 2.

Table 2. Lamb Gain Data (Pounds), June 25 to August 19, 1965

Lot No.	Space allotted	No. of lambs	Weight		Average daily gain	Feed per pound gain
			Initial	Final		
	sq. ft.		lb.	lb.	lb.	lb.
1	4	16	59.6	86.1[a/]	0.499[a/]	5.5
2	6	16	58.9	83.1[a/]	0.455[a/]	6.3
3	8	16	58.0	86.1	0.511	5.9
4	10	16	58.7	88.1	0.534	5.4

a/ One lamb died in each lot, and gain data are based on 15 lambs.

No significant difference in average daily gain could be attributed to the various spacings. The lambs with six square feet of area gained 0.455 pound per head daily compared with 0.534 pound per head daily for the lambs with ten square feet of space.

Two lambs died, one in the four-foot spacing and one in the six-foot. These lambs were replaced to maintain the planned concentration; however, the gain data for the replacement lambs as well as for the lambs that died were not included in the analysis of performance of the lambs. Use of the 3-milligram implant of DES increased gains 13 percent without having any apparent relation to floor space.

The incidence of lambs showing symptoms of overheating (four recorded) or requiring attention for rectal prolapses (three recorded) also did not seem to be connected with floor space.

Although feed data were not statistically analyzed, there seemed to be no significant difference that could be related to floor space. More feed was required to produce a pound of gain than in past years. The ration was fed in the meal form, and some bridging occurred in feeders used in the test. Lambs in all lots tended to waste part of their feed.

Fecal material did not collect in appreciable amounts on the slats in any lot. However, the accumulation was smallest in lots having the heaviest concentration of lambs.

The average high temperature in the lots for the first week of the study was 87.6° F. In five of the remaining seven weeks, temperatures varied less than one degree from this average. The highest sustained temperatures were recorded in the final week, when the range was 92° to 97° F. for six of the seven days, with an average high of 94.1° F. for the week. Judging from other observations, the high temperatures experienced during the last week of the study probably had an adverse effect on the off-experiment weights.

Conclusions

The 1965 study involved more lambs than the 1964 study, and the treatments were replicated. As in 1964, these results indicated that (1) early-weaned lambs gained satisfactorily when confined to four square feet of floor space; (2) internal parasite and maggot strikes were not a problem when lambs were confined to a very limited area on elevated slotted floors; (3) fecal material did not collect on the floors, and lambs remained relatively clean; (4) a 3-milligram implant of DES significantly increased gains; and (5) if lambs are to be closely housed for an extended period on elevated slotted floors, a system of manure disposal should be provided.

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ALTERING THE DIGESTIVE PROCESSES OF LAMBS

M. R. KARR, U. S. GARRIGUS, E. E. HATFIELD, and R. P. LINK

SHEEP and other ruminants have an advantage over simple-stomached animals in being able to utilize fibrous feeds more efficiently. This is due to the symbiotic action of rumen microflora which converts the feeds into simpler fatty acids and other substances.

With an all-concentrate ration, however, the rumen's action is less efficient than the direct digestive processes of the simple-stomached animal. This raises the question as to whether we can eliminate the intermediate step of rumination when an all-concentrate ration is fed.

After 110 days of experimentation, lambs receiving high levels of antibiotics and sulfa-drug (left) were markedly larger than the control lambs (right).

Usual rumen development

It is well known that the rumen is not fully developed at birth and that the digestive processes of the very young ruminant are more like those of a simple-stomached animal than a mature ruminant. During the first few weeks of life the rumen mucosa, which is relatively smooth at birth, becomes highly papillated. The papillary development has been related to intake of dry feed and more specifically to propionic and butyric acids, end-products of ruminal fermentation.

Hypothesis tested

If rumen papillary development depends upon fermentation within the rumen, it should be possible to prevent rumen development by inhibiting ruminal microorganisms. This hypothesis was tested in a preliminary study of 2-week-old lambs.

All lambs received a concentrate ration adequate in amino acids and vitamins, but low in crude fiber (suitable for baby pigs). In an attempt to inhibit growth of rumen microorganisms, test lambs received 1,840 milligrams of antibiotics and sulfa-drug per pound of diet. Control lambs received 10 milligrams of antibiotic per pound of diet (a normal level).

Good gains on test diet

During the first 42 days of the experiment the lambs had access only to their mother's milk and their assigned creep diet. From weaning until slaughter the lambs had access to the creep diet only.

As shown by the following figures, both groups made relatively efficient gains for ruminants on a finishing-for-slaughter program, but the test (high-drug) lambs did much better than the control lambs:

	Control lambs	*Test lambs*
First 42 days	*pounds*	
Av. daily gain	0.50	0.75
Feed per lb. of liveweight gain[a]	0.90	0.73
Weaning to slaughter		
Av. daily gain	0.52	0.75
Feed per lb. of liveweight gain	4.1	3.7

([a] In addition to mothers' milk.)

Test lambs had an average daily feed intake of 1.69 pounds; control lambs, 1.32 pounds. Because of the test lambs' more rapid gain in weight, however, their feed intake represented a smaller percentage of body weight (3.1 percent) than did the control lambs' intake (3.3 percent).

Obviously the lambs fed high levels of antibiotics and sulfa-drug made more efficient use of the ration. This may be partly explained by some observations made during the course of the study.

The papillae or protuberances on the rumens of the control lambs were denser and shorter than those of the test lambs. The high-drug treatment evidently changed the fermentation pattern: Rumen fluid from the test lambs had a significantly lower concentration of total volatile fatty acids (64 micromoles per milliliter vs. 96 for the control lambs), and of propionic acid (36 percent vs. 46 percent). Valeric acid content, however, was higher in the test lambs (8.1 percent vs. 3.3 percent).

Protozoa were not observed in the rumen fluid of either group. A normal drop in blood glucose was observed in both groups during the first 6 weeks of experiment.

What is the significance?

Since carcasses of treated animals are not now approved for human consumption, these studies do not yet have a practical application. The data do indicate that the antibiotics and sulfa-drug inhibited and altered ruminal fermentation. This observation encourages further basic studies of rumen activity.

M. R. Karr was formerly Assistant in Animal Science; U. S. Garrigus is Professor and E. E. Hatfield, Associate Professor of Animal Science; R. P. Link is Professor of Veterinary Research.

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ILLINOIS "SPOT" WOOL MARKETING POOLS

The establishment of two "spot" wool marketing pools in Illinois has been successful in substantially increasing the returns to wool producers. Because these pools handle a large volume of graded wool, they have been able to get competitive bids that have helped to establish prices for all Illinois wool (sold either through the wool pools or to other independent or cooperative buyers) in line with top prices paid for wool from other areas.

Personnel of the Cooperative Extension Service and persons in the areas interested in the industry were responsible for initiating these "spot" pools. Additional information about them may be obtained by contacting Gary E. Ricketts, Animal Science Department, University of Illinois, Urbana; George D. Perisho, Farm Adviser, Peoria; or J. M. Lewis, Dixon Springs Agricultural Center, Simpson.

The following tables show volumes and prices for 1965:

Table 1. Dixon Springs Wool Pool, 1965

Grade	Weight, lb.	Price per lb.
Fine staple	4,111.5	$.49
1/2 staple	3,897.5	.52
3/8 staple	8,989.5	.58
1/4 staple	6,235.5	.61
Low 1/4 staple	211.5	.61
Common and braid	183.5	.50
Fine clothing	330.0	.44
1/2 clothing	582.0	.47
3/8 clothing	2,027.0	.55
1/4 clothing	1,148.0	.57
Medium lamb	952.5	.46
Medium burry	164.5	.54
Cotted	--	--
Black and gray	208.0	.45
Dead	157.0	.55
Crutchings	293.0	.20
Tags	619.0	.15
Fine lamb	851.5	.40
Fine burry	26.0	.42
Total	30,987.5	

Table 2. Peoria Wool Pool, 1965

Grade	Weight, lb.	Price per lb.
Medium		
1/4 staple) 3/8 staple)	50,922	$.62
1/4 clothing) 3/8 clothing)	34,056	.60
Low 1/4	6,039	.61
Burry and seedy	1,321	.55
Fine		
Fine staple	4,018	.50
Fine clothing	344	.40
Burry and seedy	99	.35
1/2 blood		
Staple	7,077	.53
Clothing	545	.43
Burry and seedy	--	--
Common and braid	--	--
Black and gray	1,340	.55
Lamb		
Short	3,555	.48
Medium	7,440	.51
Fine	3,918	.44
Dead	543	.55
Cotted	78	.50
Crutchings	606	.23
Tags	3,648	.18
Kempy	65	.25
Musty and moldy	294	.50
Total	125,908	

Assistance of the Livestock Division, Wool Laboratory, Consumer and Marketing Service, United States Department of Agriculture, Denver Federal Center, Denver, Colorado (Mr. Elroy Pohle, in charge), proved to be of both educational and professional benefit in helping producers to more accurately evaluate their wool.

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COMMENT ON LIVE ANIMAL AND CARCASS EVALUATION

B. B. Doane

Carcass shows are a relatively new method of evaluating livestock. They were conceived and initiated by livestock people who were becoming increasingly concerned about the characteristics that influenced the value of the end-product of their production, meat. Therefore, they thought it would be logical to place more emphasis on shows that would more accurately and objectively measure the ultimate value of livestock. Consequently, carcass shows have become more common and significant in the past few years.

The Reciprocal Meat Conference, an organization consisting of persons engaged in teaching, research, and extension in areas associated with production, evaluation, processing, marketing, and utilization of meat products, defined the primary objective of carcass contests as follows: "Quality carcass contests should provide educational information to all segments of the meat industry, including exhibitors, educators, packers, marketing agencies, meat purveyors, retailers, and spectators." They further proposed a carcass contest to recognize and identify those carcasses that appropriately combine the yield of salable product with the quality of that product.

The following procedures for quality lamb contests have been recommended by the Reciprocal Meat Conference:

1. Quality lamb contests should require lambs to be shorn within the 30-day period prior to showing (to allow more critical evaluation if shown on foot).

2. When possible, show or display all entries on foot for educational purposes.

3. Optional - establish classes by breed or on an all-breed basis.

4. Slaughter and code all lambs to prevent the possibility of ownership identification by the judging committee.

5. When possible, have a committee of three judges, preferably one from industry, one from a college or university, and one from the U.S.D.A. Grading Service.

6. Carcasses should fall within a 40- to 60-pound weight range.

7. When the cooperating packer will permit, the carcasses should be ribbed perpendicularly to the long axis of the longissimus dorsi muscle so that one rib remains on the hind saddle.

8. Loin eyes should be traced and then measured with a compensating polar planimeter. Fat thickness over the eye should be taken at the center of the long axis of the eye and at each end where the curve starts. These three measurements should be averaged. An additional fat measurement should be made 3 inches beyond the lateral edge of the loin eye muscle.

9. Judges should make their decisions, using their estimation of:

a. Cutability based on:

(1) Relative proportion of parts.
(2) Area of loin eye.
(3) Fat thickness over loin eye, breast, and other outside areas.
(4) Kidney and pelvic fat.

b. Quality based on:

(1) Firmness of lean and fat.
(2) Color of lean and fat.
(3) Marbling.
(4) Color and porosity of bone.

10. Carcasses should be grouped into five categories as follows:

1-a Carcasses with highly desirable conformation with a uniform but not excessive fat covering, that are thickly fleshed and have excellent quality meat. They should have minimal amounts of kidney and pelvic fats and quality equal to or exceeding U.S. Average Choice (small to modest amounts of marbling in a bright brick red color of lean in the rib eye). Loin eye areas per 100 lb. carcass weight and fat covering over the loin eye should meet the following specifications:

Carcass weight	Minimum loin eye area per 100 lb. carcass	Maximum fat thickness (in.)
40-45	4.50	.35
46-50	4.40	.35
51-55	4.30	.40
56-60	4.20	.40

2-a High-quality lamb carcasses with quality equal to that in 1-a but with a slightly less than minimum loin eye area or slightly more than maximum fat or both, or with somewhat less desirable conformation.

3-a High-quality lamb carcasses that are lacking in muscling and/or are excessively wasty, resulting in low cutability.

1-b Lamb carcasses with very desirable conformation but with quality below Average Choice.

2-b Lamb carcasses lacking in both conformation and quality.

Place the carcasses numerically on an individual basis, using 1-a carcasses first and then 2-a and perhaps 1-b carcasses.

Most of the lamb carcass contests being held now have been set up to follow these recommendations of the Reciprocal Meat Conference. However, many other innovations have been initiated. In some contests the final carcass placings are made by calculating an actual dollars-and-cents value for the carcass. This method necessitates cutting the carcass into wholesale cuts and applying a value to each cut. Other contests use different methods of placing carcasses. About as many methods and formulae are being used as there are carcass judges. Such phrases and terms as yield of trimmed retail cuts, percent of lean in carcass, percent of edible portion, leg-loin index, and others are being used, and each is calculated a little differently. All are an attempt to describe and evaluate a very desirable carcass. However, the lack of uniformity confuses many people.

It appears that the carcass shows are fulfilling the major objective of being educational. Producers and livestock judges have become more aware of what is under the hide of a beast and are doing a much better job of appraising and evaluating live animals. Still, there is much to be learned. Research personnel have been stimulated to try to produce meatier carcasses more economically through the use of genetic information and improved nutrition. Meats personnel are striving to improve techniques of evaluating and merchandising a more acceptable product.

Probably the most obvious change in carcasses since the initiation of carcass shows has been the reduction in fat covering. At the beginning, most lambs carried more than 0.4 inch of fat over the loin, many going as high as 0.7 or 0.8 inch. Today a lamb with more than 0.25 inch of fat seldom wins a show, and many winners have 0.15 inch or less. Not only have the carcasses become less fat and wasty, but they have also become slightly longer, especially through the rump and loin, and they have become trimmer middled and smoother shouldered. The average loin eye size has also increased.

It appears that the average lamb in a carcass show today is superior to the average of a few years ago when evaluated on the quality and quantity of merchandisable meat he will produce per unit of body weight.

Carcass shows are not conducted without any problems. Finding a packer who can slaughter and handle lambs according to contest rules seems to be one of the major problems. The requirement for "breaking" the carcass has made some packers reluctant to cooperate. Maintaining positive identity of the carcass is also a problem. Additionally, the lack of uniformity in carcass requirements confuses many producers.

Although progress has been made in selecting and producing more desirable meat animals, the industry must continue to improve. In striving to improve, it must realize that there may be hazards along the way. A product must not be selected as "desirable" if it is highly impractical and uneconomical to produce. An attempt must always be made to recognize animals that have been produced under conditions that are not economic.

In summary, carcass shows must select animals that have "producer practicality" on foot and "consumer acceptance" in the meat market. Neither objective can be placed above the other. The two should be equal if carcass shows are to accomplish their intended purpose.

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USE OF K-40 IN SHEEP RESEARCH

T. G. Lohman, E. E. Hatfield, U. S. Garrigus,
B. C. Breidenstein, and B. B. Doane

During the past five years, increasing research has been done to determine the relation between body potassium and body composition in livestock. These efforts have been stimulated by the development of the whole-body liquid scintillation counter, which measures the naturally occurring K-40 gamma radioactivity in the live animal. Measurement of the K-40 gamma activity, in turn, makes it possible to estimate the total potassium in the animal. Since most of the potassium is found in the lean tissue, an attempt is now being made to determine whether the potassium content of the whole body, as well as that of the lean tissue, is constant enough for the K-40 measurement to provide an accurate index of body composition, particularly carcass lean or protein and carcass fat.

The Illinois Animal Science Counter (Illasco) was constructed in the fall of 1962. During the first year of its operation, the K-40 method was compared with the specific gravity method, another indirect technique for estimating carcass lean. Results on 97 sheep carcasses indicated a close relation between the two methods, the carcass potassium accounting for 88 percent of the variation in pounds of protein (estimated from specific gravity), with a standard error of estimate of 4.7 percent.

In the second and third years, the whole-body counter was used mainly in an extensive study in cattle to relate whole-body and carcass K-40 to carcass lean. Illinois researchers report that when procedures were used to control a number of important sources of variation, particularly the radioactivity of the gastrointestinal contents, the whole-body count appeared to be as accurate as the carcass count in predicting carcass lean muscle mass. In these cattle, whole-body potassium together with body weight predicted the carcass lean muscle mass (CLMM) with a standard error of estimate of 3.5 percent of the mean CLMM weight (3.5 lb. per 100 lb. of CLMM).

To further evaluate the potential usefulness of the K-40 method in sheep, a study was recently conducted to compare whole-body and carcass K-40 radioactivity with the direct measurement of CLMM. CLMM was determined by physically separating the right side of the carcass into separable lean, bone, and fat. The separable lean was further analyzed for the remaining fat to get a fat-free lean tissue weight for each sheep. In addition to whole-body counting, a number of other measurements were taken on the same sheep to compare the K-40 method with other indirect methods for estimating carcass lean. These measurements included live weight, age at slaughter, carcass weight, specific gravity, loin-eye area, fat thickness at the 12th rib, weight of the kidney and pelvic fat, and carcass cut-out data, including the leg and salable meat.

All sheep came from a similar genetic background, having been born to western ewes that had been crossed with Hampshire rams. Sixteen of the 27 sheep used in this study were ewes, and 11 were rams. At about 74 days of age, they

were allotted to four semipurified diets consisting primarily of ground corn, soybean meal, and solka floc, the diets differing mainly in level of protein. The average age at slaughter was 144 days.

The means and standard deviations for a number of measurements are given in Table 1.

Table 1. Live Sheep and Carcass Measurement (n = 27)

	Mean	Standard deviation
Live weight, lb.	73.6	8.6
Carcass weight, lb.	41.4	5.7
Age, days	144.0	3.0
Specific gravity	1.0448	0.0094
Loin-eye area, sq. in.	2.15	0.28
Leg, lb.	8.4	1.1
Salable meat, lb.	26.7	3.3
Whole-body potassium, gm.	70.9	7.9
Carcass potassium, gm.	44.8	5.7
Carcass lean muscle mass, lb.	21.4	2.9

As can be seen, the sheep in this group were fairly uniform in weight and in CLMM. The CLMM averaged 29.1 percent of the live weight and 51.9 percent of the carcass weight. Of the total body potassium, 63 percent was found in the carcass.

Prior to whole-body counting, the sheep were sheared and washed, but no attempt was made to control the radioactivity in the gastrointestinal tract. The estimate of whole-body potassium was based on a total of 16 minutes of counting time, 8 minutes of which were counted on one day and the other 8 minutes two days later.

Results showed that the mean whole-body potassium increased by 3 percent from the first to the second count. Accounting for this day effect, the experimental error was 2.5 percent. Thus the measurement on the individual sheep was found to be repeatable from day to day. For the sheep carcasses, there was no significant difference in the average carcass potassium from one day to the other, and the experimental error in the potassium determination was 3.1 percent.

In the relation of various indirect methods to the actual determination of carcass lean, live weight was found to account for 51.1 percent of the variation in CLMM, with a standard error of estimate[1/] of 2.0 lb., 9.3 percent of the mean CLMM weight (Table 2).

1/ The standard error of estimate indicates that, in this sample of sheep, CLMM was estimated within 9.3 percent (9.3 lb. per 100 pounds CLMM) in two of every three sheep.

Table 2. Comparison of Several Indirect Measurements Used Separately to Predict Carcass Lean Muscle Mass (CLMM)

Indirect measurement (Independent variable)	Direct measurement of carcass lean muscle mass (Dependent variable)		
	Percent of variation accounted for	Standard error of estimate	
	$r^2 \times 100$	Lb. of CLMM	% of mean CLMM weight
Live weight	51.1	2.00	9.3
Carcass weight	53.3	1.94	9.1
Loin-eye area	56.6	1.88	8.8
Whole-body potassium	76.6	1.36	6.4
Leg	82.9	1.17	5.5
Carcass potassium	90.3	0.88	4.1
Salable meat	91.0	0.85	4.0

Carcass weight accounted for 53.3 percent of the variation in CLMM, loin-eye area accounted for 56.6 percent, and the whole-body potassium, based on the K-40 count, accounted for 76.6 percent, with a standard error of 6.4 percent. Cutout data on the leg predicted CLMM with a standard error of 5.5 percent. The carcass potassium and carcass salable meat each estimated the carcass lean with standard errors of 4.1 and 4.0 percent, respectively. These results do not represent the full accuracy provided by the counter and the other indirect measurements, because the direct determination of carcass lean is subject to errors of as yet undetermined magnitude.

Use of live weight, carcass weight, age, and sex together (referred to as the basic model) made it possible to predict carcass lean with a standard error of 7.3 percent (Table 3). Use of carcass specific gravity, calculated by weighing the carcass under water, along with the basic model, decreased the standard error to 6.2 percent. When carcass loin-eye area or whole-body potassium was used along with the basic model, the predictive ability was about the same as when carcass specific gravity was used with the basic model. The combination of loin-eye area, fat thickness, and kidney and pelvic fat along with the basic model decreased the standard error to 5.0 percent. Use of carcass potassium with the basic model predicted CLMM with about the same accuracy as carcass potassium alone and with slightly greater accuracy than the combination of carcass measurements. Cutout data yielding an estimate of the total salable meat in the carcass accounted for 94.2 percent of the variation in CLMM with a standard error of 3.5 percent. Cutout data from the leg accounted for about the same amount of variance in CLMM as salable meat.

The fact that only 63 percent of the total potassium was found in the carcass will help to explain the discrepancy between whole-body and carcass potassium in estimating carcass lean muscle mass. Furthermore, whole-body potassium could account for only 80 percent of the variation in carcass potassium. Thus, although these sheep were on a semi-purified diet, it appears that variability in the radioactivity of the gastrointestinal contents or of other noncarcass components may have limited the predictability of CLMM.

Table 3. Comparison of Several Indirect Measurements Used Simultaneously to Predict Carcass Lean Muscle Mass (CLMM)

Indirect measurement (Independent variables)	Direct measurement of carcass lean muscle mass (Dependent variable)	
	Percent of variation accounted for (r^2 x 100)	Standard error of estimate (percent of mean CLMM weight)
Basic model Live weight, carcass weight, age, and sex	74.7	7.3
Basic model plus		
Specific gravity	82.8	6.2
Loin-eye area	83.5	6.0
Whole-body potassium	83.6	5.9
Loin-eye area, fat thickness, kidney and pelvic fat	89.7	5.0
Carcass potassium	90.6	4.4
Leg	93.9	3.6
Salable meat	94.2	3.5

Whole-body and carcass K-40 data have recently been collected on an additional 53 sheep in which radioactivity in the gastrointestinal tract was controlled by feeding a low-counting diet for four days before counting. These results should indicate the degree to which whole-body potassium estimates can approach the accuracy of carcass potassium in predicting carcass lean.

One of the first applications of the K-40 method at Illinois was in a sheep selection study, now in its second year. The objectives were to evaluate the K-40 method as a measure of carcass lean muscle mass, to determine the heritability of whole-body potassium, and to evaluate the method for selecting breeding stock for increased protein growth potential.

In the first year of this study, a flock of 120 ewes (14 months old) and 24 rams (4.5 months old) of the Hampshire breed were weighed and K-40-counted. On the basis of live whole-body K-40 count, the ewes were allocated into three groups of 40 each--high, medium, and low. The two rams with the highest K-40 count were mated with ewes of the high group, two rams with lowest counts were mated with ewes of the low group, and two rams with counts near the mean for rams were mated with ewes of the medium group.

The rams and about 10 of the original 40 ewes in each group will be replaced each year by offspring from their own group, (a) the highest-count lambs replacing the lowest-count mature sheep in the high group, (b) lowest-count lambs replacing highest-count mature sheep in the low group, and (c) randomly selected individuals replacing randomly selected original parents in the medium group. Thus maximum selection pressure will be maintained in the high and low groups, and a control group will be kept from the medium parent stock.

Most of the ram lambs and about one-third of the ewe lambs from each lamb crop will be available for performance-testing under standardized conditions, including K-40 count just prior to slaughter. Carcass lean muscle mass will be measured by K-40 count and by dissection and chemical analysis, and carcass quality characteristics will be assessed.

The mean whole-body potassium values for the three groups of the original flock are given in Table 4.

Table 4. Whole-Body Potassium in Sheep, Selected on the Basis of a High, Medium, and Low K-40 Count

	High count		Medium count		Low count	
	Rams(2)	Ewes(24)	Rams(2)	Ewes(38)	Rams(2)	Ewes(28)
	K, gm.		K, gm.		K, gm.	
Original flock (Ewes 14 months old) (Rams 4.5 months old)	110.0	107.4	89.7	98.2	80.8	87.4

	Rams and Ewes(34)	Rams and Ewes(47)	Rams and Ewes(37)
	K, gm.	K, gm.	K, gm.
Offspring[a/] (4 months old)	92.4	91.1	87.7

a/ Potassium values are adjusted for differences in sex, type of birth, and month of birth.

This table also gives values for the offspring adjusted for differences in sex, type of birth, and month of birth. Because the original ewes were counted at 14 months of age and the offspring were counted at 4.5 months, the difference between the two generations is affected not only by the selection pressure, but also by the extent to which the count at 14 months differs from that at 4.5 months. Hence, we do not yet have comparable data for successive generations. The selection study will be continued at least through 1969.

In summary, results to date indicate that whole-body potassium offers additional information on carcass composition over that gained from live or carcass weight alone. At present whole-body potassium is comparable with other indirect carcass measurements, excluding carcass cutout, in predicting carcass lean. Carcass potassium, on the other hand, was found to be comparable with carcass cutout in estimating carcass lean, indicating the potential of the whole-body count under carefully controlled conditions.

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SUMMARY OF 1964 EWE FLOCK PRODUCTION

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The efforts of all of you who cooperated in filling out and returning the Summary of 1964 Ewe Flock Production are appreciated. The analysis of these summaries, which appears in Table 1, provides a lot of useful information that you can use in evaluating your own flock's performance. In order to compare all flocks on a commercial ewe flock basis, "lambs on hand" were given a market value comparable to that of lambs which were sold, and the value of purebred lambs was also determined on a market basis. The summaries were divided into four groups according to number of ewes: 10-25, 26-50, 51-100, and over 100.

Gross return per ewe refers to sales of lambs, wool, and incentive payments for both.

Table 1. Analysis of 1964 Ewe Flock Production Records

Item		Number of ewes per flock			
		10-25	26-50	51-100	Over 100
Number of flocks		30	31	18	6
Average number of ewes per flock		17	37	70	121
Percent of ewes failing to lamb	High	22.7	20.7	12.0	7.4
	Average	4.3	4.0	5.1	3.1
	Low	0.0	0.0	0.0	0.0
Percent of lambs born, based on number of ewes at breeding time	High	208	193	170	178
	Average	147	141	138	135
	Low	82	88	93	117
Percent of mortality--birth to weaning	High	70.4	36.2	20.2	12.1
	Average	20.1	16.2	12.2	9.8
	Low	0.0	2.6	2.2	7.1
Percent of mortality--birth to marketing	High	70.4	54.9	20.2	17.3
	Average	21.2	20.6	13.8	13.7
	Low	0.0	2.6	2.2	8.2
Gross return per ewe	High	$42.03	$48.05	$42.87	$42.94
	Average	$30.70	$31.00	$31.58	$31.90
	Low	$14.72	$15.64	$22.86	$22.77

The information in Table 1 indicates that gross returns per ewe vary widely. Figures in the summary ranged from a high of $48.05 to a low of $14.72. Twenty-four flocks had gross returns of more than $35 and eight flocks returned more than $40 per ewe. On the other hand, four flocks had gross returns of less than $20 per ewe. Some of the results that help to explain the large amount of variability in flock returns are as follows:

	High	Low
Percent of ewes failing to lamb	22.7	0.0
Percent of lamb crop born	208	82
Percent of mortality (birth to weaning)	70.4	0.0
Lamb prices received (per lb.)	$ 0.26	$ 0.13
Lamb selling weights (lb.)	120	65
12-month fleece weights (lb.)		
per ewe	15.4	6.3
per ram	23.0	6.0

It is apparent from the information obtained from the survey that well-managed flock operations can be highly profitable. In each of the four size categories, all of the high-income flocks had gross returns of more than $42 per ewe. It is time that people begin to see sheep not as scavengers of the fence rows, but as highly productive sources of potential income.

What is required in order to maximize gross return per ewe? These records indicate that (1) all ewes must lamb, (2) a high percentage of multiple births is required, (3) lamb mortality must be kept low, (4) lambs must be marketed at desirable weights and at the time of year when prices are highest, (5) heavy-shearing ewes and rams are highly essential, and (6) wool must be marketed in a desirable condition and at the highest possible price per pound. Essentially it all boils down to good management in all phases of the sheep enterprise.

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Ruminant Division
AS-629p

UREA AND AMMONIA METABOLISM IN THE RUMINANT[1/]
(Abstract for Illinois Experiment Station Report)

P. J. Caffrey

Experiments were conducted to investigate intraruminal and tissue changes in nitrogen metabolism occurring in lambs during adjustment to a urea-rich diet.

In vitro rumen fermentation studies showed that the rate at which the ruminal microorganisms assimilated ammonia was significantly higher when the inoculum came from lambs that had been "adapted" to a urea-rich (3.5 percent urea) diet than when it came from lambs fed a urea-free, high-corn diet. Ruminal ureolytic activity was, however, higher in the lambs fed the urea-free diet. Diet of the donor animal did not significantly affect the volatile fatty acid production in vitro. Intraruminal adjustments, as measured by in vitro criteria, were accomplished within 13 days after introduction of the urea-rich diet.

The rate at which the ruminal microorganisms assimilated ammonia was determined from changes in ruminal ammonia concentrations relative to polyethylene glycol after intraruminal infusion of a known amount of ammonia and polyethylene glycol. This study indicated that the maximum ability of ruminal microorganisms to assimilate ammonia was reached before the lambs had been on the urea-rich diet 19 days.

Conventional balance studies, conducted after two lambs had been on a 3.5 percent urea diet for 4, 20, and 41 days, respectively, showed no significant differences in nitrogen balance between different collection periods. Similarly, urea recycling in these lambs did not appear to be affected by the length of time the lambs had been on the urea-rich diet.

In an experiment designed to study factors influencing the utilization of intravenously infused urea, the utilization of infused urea-N appeared to be comparable in lambs that had been previously fed a urea-free, high-corn diet and those that had been fed a 3.5 percent urea diet for several months. Nitrogen balance was only slightly improved by incorporating urea in the diet as opposed to infusing it directly into the blood. Lambs receiving urea infusions retained 5.2 grams (38 percent of infused urea-N) more N daily than control lambs receiving saline infusions.

A final experiment designed to study the utilization of and possible "adaptation" to intravenously infused ammonia showed no specific "adaptation" to the infused ammonia per se, although nitrogen balance improved as the experiment progressed.

1/ Abstract of Ph.D. thesis of P. J. Caffrey, University of Illinois Library, Urbana, 1965.

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BIOLOGICAL EVALUATION OF PURIFIED DIETS FOR LAMBS WITH EMPHASIS ON UTILIZATION OF CERTAIN DIETARY COMPONENTS AS AFFECTED BY BRANCHED-CHAIN VOLATILE FATTY ACIDS[1/]

(Abstract for Illinois Experiment Station Report)

T. R. Cline

In experiments conducted to develop purified diets for ruminants, various diet components and methods of feeding were investigated. Lambs weighing 30 kilograms (66 pounds) were used in these tests.

A study of sources of nitrogen showed that isolated soy protein supported more adequate growth than did biuret or a combination of biuret and urea and that the lambs could gain on a diet containing biuret as the sole nitrogen source.

The lambs would not voluntarily consume a diet that contained high levels (80 percent) of either starch or cellulose. Adding a mixture of sodium and potassium bicarbonates increased voluntary consumption of purified diets.

A study of methods of feeding showed that group feeding was beneficial in terms of both feed consumption and weight gains when lambs were on purified diets.

Metabolic studies were conducted to determine the effect of branched-chain volatile fatty acids on utilization of various dietary components. A conventional balance trial was conducted with lambs consuming a purified diet containing urea as the only nitrogen source and containing 39 percent of cellulose. Half of the lambs received a mixture of isobutyric, isovaleric, and n-valeric acids. Adding the acid mixture significantly increased the apparent nitrogen digestibility and retention. The acid also improved the cellulose and dry-matter digestibility coefficients and decreased the ammonial level in the rumen at various intervals after feeding.

In a balance trial conducted with lambs consuming a diet containing 59 percent cellulose, there was no apparent advantage in terms of digestibility of diet compounds or nitrogen balance when acids were added to the diet that was equal-fed. It was determined that the amino acid composition of bacterial protein hydrolysates from acid-treated and control lambs did not differ.

1/ Abstract of Ph.D. thesis of T. R. Cline, University of Illinois Library, Urbana, 1965.

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NITRATE POISONING: A CHEMICAL AND BIOLOGICAL EVALUATION OF POTASSIUM NITRATE UTILIZATION BY THE GROWING-FATTENING LAMB[1]/

(Abstract for Illinois Experiment Station Report)

J. H. Sokolowski

Evaluation of data collected from lambs under varied nutritional regimes (long-term nitrate ingestion followed by drenching with nitrate equal to average daily intake and feeding pasture or hay plus 0.5 gram of potassium nitrate per kilogram of body weight daily) indicated that the level of methemoglobin would not adequately determine whether the animal was receiving enough nitrates to produce acute toxicity. Another criterion, physiologically available hemoglobin (PAHb), was therefore used. This measure, determined by subtracting the grams of methemoglobin per 100 milliliters of whole blood from the grams of hemoglobin per 100 milliliters of whole blood, gives a more valid assessment of the availability of hemoglobin to carry oxygen in the body.

The effect of ingested nitrates on the vitamin A and carotene status of lambs was examined by using a 2 x 3 factorial design. Semi-purified isonitrogenous rations containing 0 and 6.4 percent of added potassium nitrate plus supplemental vitamin A or carotene at recommended levels were self-fed to lambs for 83 days. Blood analyses showed no specific effect of nitrate on vitamin A or carotene status.

Since certain nitrate-utilizing microorganisms require molybdenum, and molybdenum is a necessary catalyst in nitrate reduction reactions, semi-purified rations containing 0, 4.8, and 9.6 percent of potassium nitrate, on an isonitrogenous basis, with 0, 0.001, and 0.002 percent of added molybdenum, were self-fed to lambs. A previous trial had indicated that molybdenum levels of 0.0019 percent of the ration tended to increase (not statistically significant) the average daily gain of animals receiving a ration containing 6.4 percent of potassium nitrate. This experiment did not confirm this observation.

The effect of adding inorganic sulfur (0, 0.4, and 0.8 percent) to a nitrate-containing ration (0 and 3.2 percent) was also investigated. Measurements of nitrogen and sulfur balance, feed consumption, gain in weight, liver vitamin A status, and carcass characteristics were used to evaluate the effects of the treatments. Elemental sulfur added to a diet containing 3.2 percent of potassium nitrate to raise the inorganic sulfur equivalent to 0.5 percent increased nitrogen retention (Trial I, not statistically significant; Trial II, $P < .05$). The feed required per pound of gain and the liver stores of vitamin A were increased (not statistically significant) in the nitrate rations. Carcass grade was decreased ($P < .05$) with the addition of nitrate, while endocrine weights tended to correspond with the average daily gain by treatment groups.

1/ Abstract of Ph.D. thesis of J. H. Sokolowski, University of Illinois Library, Urbana, 1965.

An examination of the parotid saliva of lambs receiving 0 and 3.2 percent potassium nitrate with 0.4 percent added sulfur indicated that nitrate additions to a basal diet tended to increase (not statistically significant) the total flow of parotid saliva, blood urea nitrogen, salivary urea nitrogen, and estimated urea recycling.

Data collected indicate that lambs are able to utilize nitrate-nitrogen relatively effectively provided that the diet is well balanced and that a major part of the energy is present as readily available carbohydrates.

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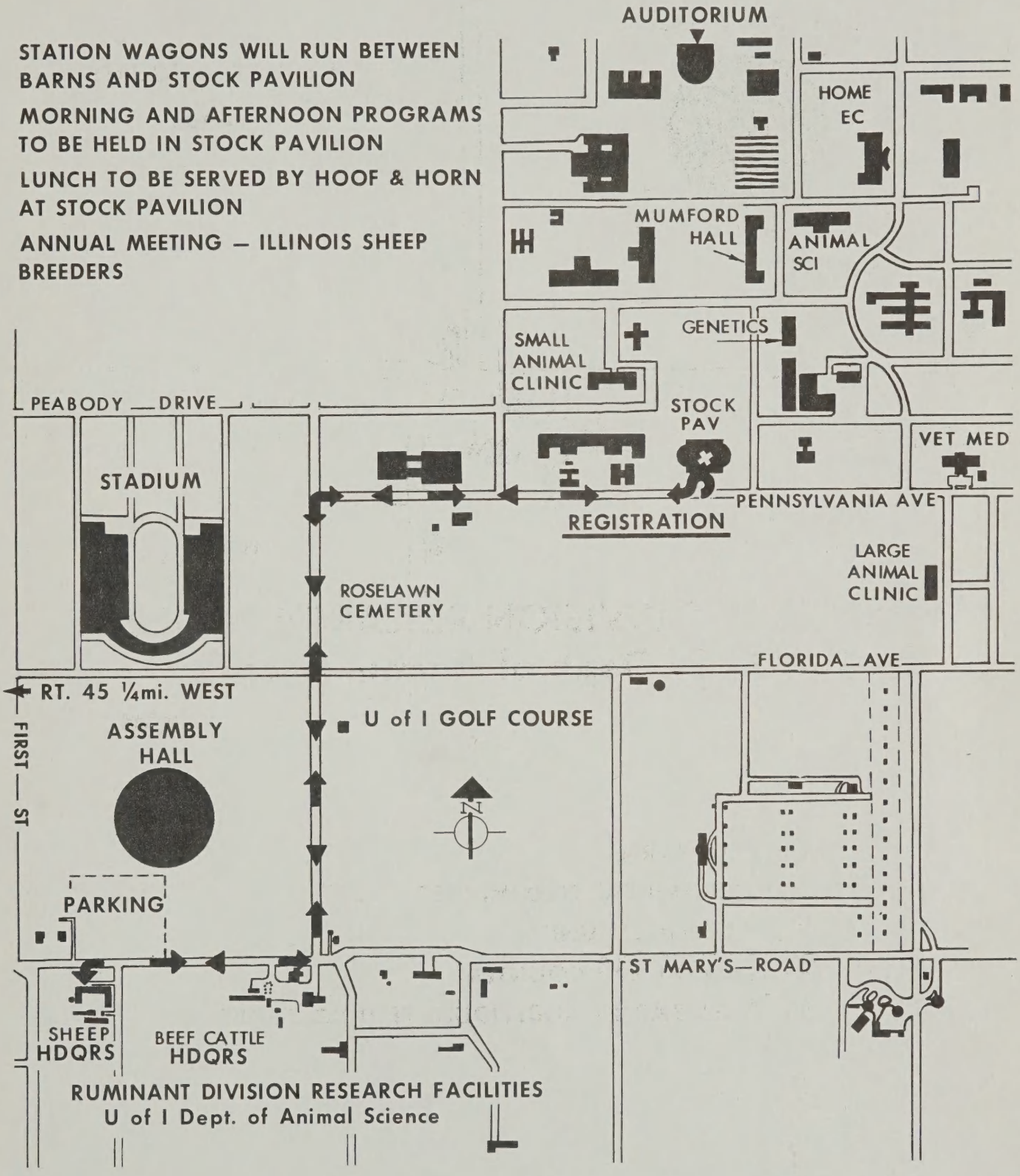
SHEEP DAY
Tour & Program Map

STATION WAGONS WILL RUN BETWEEN BARNS AND STOCK PAVILION

MORNING AND AFTERNOON PROGRAMS TO BE HELD IN STOCK PAVILION

LUNCH TO BE SERVED BY HOOF & HORN AT STOCK PAVILION

ANNUAL MEETING — ILLINOIS SHEEP BREEDERS



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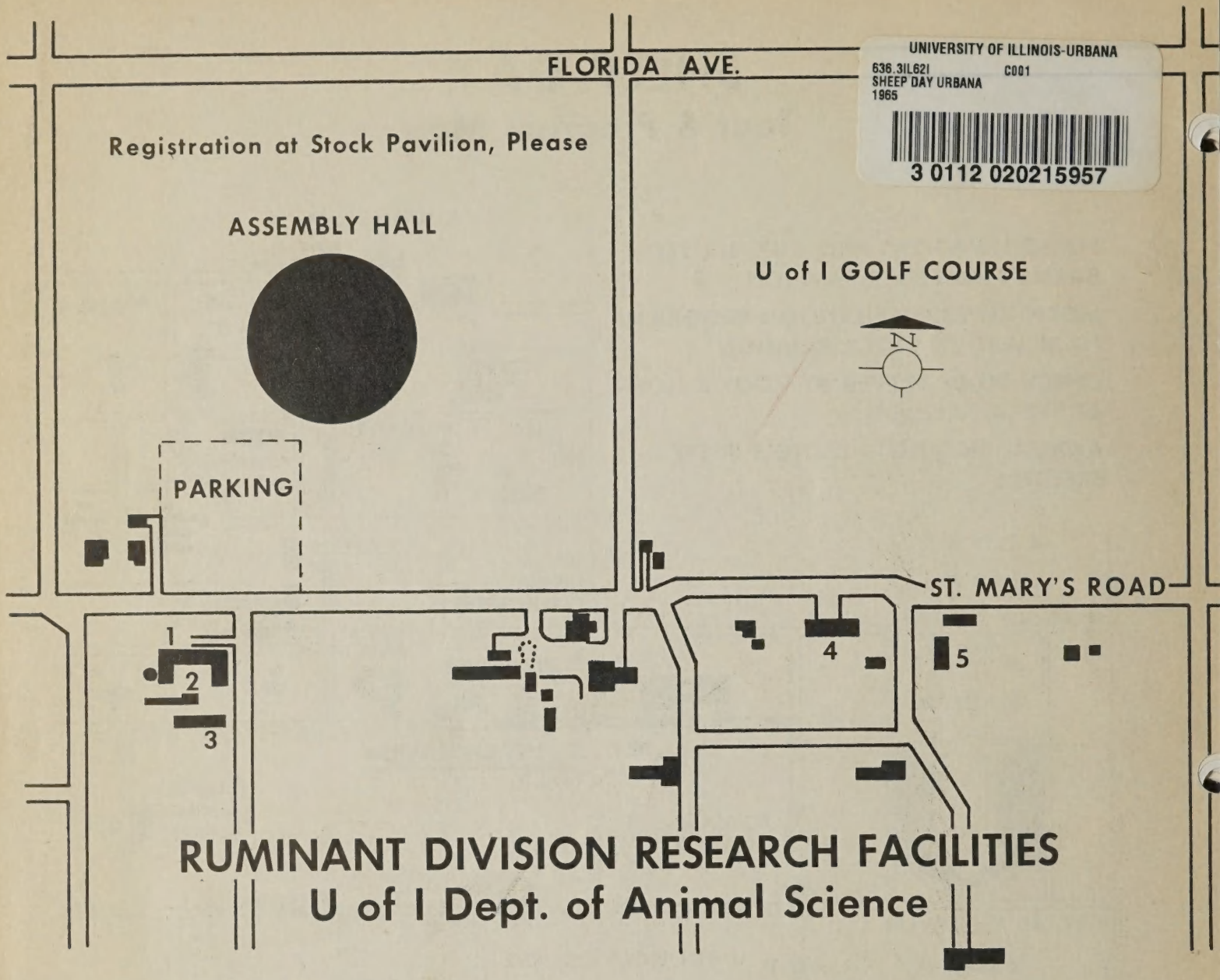

RUMINANT DIVISION RESEARCH FACILITIES

U of I Dept. of Animal Science

1 SHEEP BARN
2 EXPERIMENTAL FEED MIXING
3 METABOLISM UNIT
4 ILLASCO (K^{40} COUNTER)
5 JONES BARN — INDIVIDUAL FEEDING STUDIES